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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Michael A. Bernadicou
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Seventh Floor
12400 Wilshire Boulevard
Los Angeles, CA 90025

EXAMINER	
NOVACEK, CHRISTY L	
ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 12/20/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/771,267	BRASK ET AL.	
	Examiner	Art Unit	
	Christy L. Novacek	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 September 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *27-38* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *27-38* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the amendment filed September 29, 2005.

Response to Amendment

The amendment to the specification is sufficient to overcome the objection to the specification stated in the previous office action. Therefore, this objection is withdrawn.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., In re Berg, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); In re Goodman, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); In re Longi, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); In re Van Ornum, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); In re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and In re Thorington, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 35 and 37 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 1 of U.S. Patent No. 6,716,707. Claim 1 of US 6,716,707 recites all of the limitations of claims 35 and 37 in the current application including forming a high-k gate layer on a substrate, the high-k gate dielectric layer having impurities and oxygen, exposing the high-k gate dielectric layer to a solution including a tetraalkyl ammonium

hydroxide at a sufficient time and temperature to remove impurities from the high-k gate dielectric layer and to increase the oxygen content of the high-k gate dielectric layer, and forming a gate electrode on the high-k gate dielectric layer.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 35 and 37 are rejected under 35 U.S.C. 102(e) as being anticipated by Doczy et al. (US 6,709,911).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Regarding claims 35 and 37, Doczy discloses forming a high-k gate dielectric layer on a substrate, the high-k gate dielectric layer having impurities and oxygen, exposing the high-k gate dielectric layer to a solution including a tetraalkyl ammonium hydroxide (TMAH), and forming a gate electrode on the high-k gate dielectric layer (col. 3, ln. 51 – col. 4, ln. 15). Doczy does not

specifically disclose that exposing the high-k gate dielectric layer to the TMAH results in an increase in the oxygen content in the dielectric layer or a removal of impurities from the layer. However, because Doczy discloses subjecting the high-k gate dielectric layer to the same solution (TMAH) at the same time and temperature ranges disclosed by Applicant's specification, it appears that the TMAH cleaning process of Doczy will inherently result in an increase in the oxygen content in the dielectric layer and a removal of impurities from the layer. See *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 229 (CCPA 1971) "where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristics relied on "); and *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980) (a case indicating that the burden of proof can be shifted to the applicant to show that the subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 U.S.C. 102 or obviousness under 35 U.S.C. 103).

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 27-31 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Visokay et al. (US 20030045080, cited in IDS) in view of Boyd et al. (US 6,845,778, previously cited).

Regarding claims 27 and 38, Visokay discloses forming a high-k gate layer on a substrate, the high-k gate dielectric layer having impurities and oxygen, exposing the high-k gate dielectric layer to a solution including hydrogen peroxide at a sufficient time and temperature to remove impurities from the high-k gate dielectric layer and to increase the oxygen content of the high-k gate dielectric layer, and forming a gate electrode on the high-k gate dielectric layer (para. 0023-0033). Visokay does not disclose applying sonic energy while the high-k gate dielectric layer is exposed to the solution that includes hydrogen peroxide. Boyd discloses that it is well-known in the art to use megasonic cleaning to rid semiconductor wafers of impurities because the sonic energy applied to the wafers causes the rapid forming and collapsing of microscopic bubbles in a liquid medium under the action of sonic agitation. Upon collapse, the bubbles release energy which assists in particle removal through breaking the various adhesion forces which adhere the particle to the substrate (col. 1, ln. 10-31). Boyd teaches a megasonic cleaning apparatus that uses a hydrogen peroxide solution to clean semiconductor substrates (col. 6, ln. 20-29). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the megasonic cleaning system taught by Boyd to clean the high-k gate dielectric layer of Visokay because Visokay does not disclose using any particular cleaning apparatus and because Boyd teaches that by applying sonic energy to the cleaning solution, better impurity removal can be obtained.

Regarding claims 28 and 29, Boyd discloses that the sonic energy can be applied at a frequency of 400-1500kHz, while dissipating at 3-5 W/cm^2 (col. 6, ln. 40-48).

Regarding claims 30 and 31, Visokay discloses that, in one example, the hydrogen peroxide solution is an aqueous solution containing 5% hydrogen peroxide by volume and the

high-k gate dielectric layer is exposed to the aqueous solution at a temperature of 65°C for 7 minutes (para. 0024). Visokay does not disclose a range of cleaning parameters. At the time of the invention, it would have been obvious to one of ordinary skill in the art to use routine experimentation to determine optimal H_2O_2 concentrations, time and temperatures at which to conduct the cleaning process of Visokay, depending upon the composition and thickness of the high-k gate dielectric layer because such variables of art recognized importance are subject to routine experimentation and discovery of an optimum value for such variables is obvious. See *In re Aller*, 105 USPQ 233 (CCPA 1955). Note: Applicant's specification, page 6, lines 13-16 states, "The appropriate time and temperature at which high-k gate dielectric layer is exposed [to the cleaning solution] may depend upon the desired thickness and other properties for high-k gate dielectric layer **110**."

Claims 32-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Visokay et al. (US 20030045080) in view of Boyd et al. (US 6,845,778) as applied to claim 27 above, and further in view of Ahn et al. (US 20040043569).

Regarding claims 32 and 33, Visokay discloses that there are impurities in the high-k gate dielectric layer but does not specifically disclose that these impurities include chlorine. Visokay teaches that a variety of methods such a CVD and PVD may be used to deposit the high-k gate dielectric layer (para. 0020). Like Visokay, Ahn discloses a process of forming a high-k gate dielectric layer made of hafnium silicon oxynitride. Ahn teaches that the high-k gate dielectric layer should be deposited using an ALD-CVD process because the ALD-CVD process offers the advantage of being able to precisely control the thickness of the gate dielectric layer (para. 0009). Additionally, Ahn teaches that sputtering the high-k gate dielectric film is not desirable

because the sputtering process causes an interfacial SiO_2 film to be formed on the surface of the substrate which limits the equivalent oxide thickness scaling that can be attained for the gate dielectric (para. 0035). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the ALD-CVD process taught by Ahn to deposit the high-k gate dielectric layer of Visokay because Ahn teaches that ALD-CVD provides significant advantages to the gate dielectric layer over sputtering and other deposition methods. Ahn teaches that the process of using ALD-CVD to deposit the high-k gate dielectric layer involves using a metal chloride precursor, such as $HfCl_4$, and a silicon chloride precursor, such as $SiCl_4$ (para. 0064, 0069). Using $HfCl_4$ and/or $SiCl_4$ precursors for the deposition of the gate dielectric layer ensures that impurities of chlorine will inherently be formed throughout the high-k gate dielectric layer.

Regarding claim 34, Visokay discloses depositing a high-k gate dielectric layer on a substrate and subjecting the high-k gate dielectric layer to a liquid cleaning solution of hydrogen peroxide in order to remove impurities from the gate dielectric layer. Visokay does not specifically disclose the percentage of impurities removed from the layer. At the time of the invention, it would have been obvious to one of ordinary skill in the art to use routine experimentation to determine optimal time and temperatures at which to conduct the cleaning process of Visokay in order to achieve removal of 80% or more of the impurities, depending upon the composition and thickness of the high-k gate dielectric layer and the concentration of the cleaning solution because such variables of art recognized importance are subject to routine experimentation and discovery of an optimum value for such variables is obvious. See *In re Aller*, 105 USPQ 233 (CCPA 1955). Note: Applicant's specification, page 6, lines 13-16 states, "The appropriate time and temperature at which high-k gate dielectric layer is exposed [to the

cleaning solution] may depend upon the desired thickness and other properties for high-k gate dielectric layer **110**."

Claims 35 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Visokay et al. (US 20030045080).

Regarding claims 35 and 36, Visokay discloses forming a high-k gate layer on a substrate, the high-k gate dielectric layer having impurities and oxygen, exposing the high-k gate dielectric layer to a solution including water at a sufficient time and temperature to remove impurities from the high-k gate dielectric layer and to increase the oxygen content of the high-k gate dielectric layer, and forming a gate electrode on the high-k gate dielectric layer (para. 0023-0033). Visokay does not specifically state that the water used in the treatment process is deionized water. At the time of the invention, it would have been obvious to one of ordinary skill in the art to use deionized water for the water recited by Visokay because deionized water offers the advantage of having contaminating impurities such as calcium, sodium and chlorine ions removed therefrom.

Response to Arguments

Applicant's arguments filed September 29, 2005 have been fully considered but they are not persuasive.

Regarding the rejection of claim 27 as being unpatentable over Visokay in view of Boyd, Applicant argues that there is allegedly no motivation to combine the references. Visokay teaches a process of removing impurities from a layer of an integrated circuit using a liquid cleaning process. Boyd teaches that it is advantageous to conduct a liquid cleaning process for

layers of an integrated circuit in a megasonic cleaner because the application of sonic energy to the integrated circuit during the cleaning operation provide greater cleaning power and cleaning efficiency. Thus, the motivation to use the sonic energy taught by Boyd in the cleaning process disclosed by Visokay is that the sonic energy provides greater cleaning power and cleaning efficiency.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (571) 272-1839. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CLN
December 6, 2005

ZANDRA V. SMITH
PRIMARY EXAMINER
12/7/05